

What is claimed is:

- 1) A semi-crystalline, largely isotropic, carbon foam produced from particulate high volatile bituminous coal exhibiting a free swell index of between about 3.5 and about 5.0 and of a small diameter, said carbon foam having a density of between about 0.1 and about 0.8 g/cm³ and a thermal conductivity below about 1 W/m/°K.
- 2) The carbon foam of claim 1 wherein said coal exhibits a free swell index of between about 3.75 and about 4.5.
- 3) The carbon foam of claim 2 having a compressive strength below about 6000 psi.
- 4) The carbon foam of claim 2 that has been carbonized.
- 5) The carbon foam of claim 2 that has been graphitized.
- 6) A method for producing a carbon foam from a high volatile bituminous coal exhibiting a free swell index of between about 3.5 and about 5.0 comprising:
 - A) comminuting said high volatile bituminous coal to a small particle size to form a ground coal;
 - B) placing said ground coal in a mold;

- C) heating said ground coal in said mold under a non-oxidizing atmosphere to a temperature of between about 300° C and about 700° C and soaking at this temperature for a period of from about 10 minutes to about 12 hours to form a preform; and
 - D) controllably cooling said preform.
- 7) The method of claim 6 wherein said high volatile bituminous coal exhibits a free swell index of between about 3.75 and about 4.5.
- 8) The method of claim 7 wherein said inert atmosphere is applied at a pressure of from about 0 psi up to about 500 psi.
- 9) The method of claim 7 wherein said temperature is achieved using a heat-up rate of between about 1° C to about 20° C per minute.
- 10) The method of claim 7 wherein said controlled cooling is accomplished at a rate of less than about 10° C/min to a temperature of about 100° C.
- 11) A laminated sheet comprising:
 - A) a pair of skins laminated to either side of;
 - B) a core of a semi-crystalline, largely isotropic, carbon foam produced from particulate high volatile

bituminous coal exhibiting a free swell index of between about 3.5 and about 5.0 and of a small diameter, said carbon foam having a density of between about 0.1 and about 0.8 g/cm³ and a thermal conductivity below about 1 W/m/°K.

- 12) The laminated sheet product of claim 11 wherein said coal exhibits a free swell index of between about 3.75 and about 4.5.
- 13) The laminated sheet product of claim 12 wherein said skins comprise a material selected from the group consisting of aluminum, steel, polymer sheet, inconel, titanium, refractory metals, fiber reinforced polymer sheet and paper.
- 14) The laminated sheet product of claim 12 wherein said sheet core has been carbonized.
- 15) The laminated sheet product of claim 12 wherein said sheet core is graphitized.
- 16) The semi-crystalline, largely isotropic, carbon foam of claim 1 wherein said high volatile bituminous coal contains between about 35% and 45% by weight of volatile matter.

- 17) The semi-crystalline, largely isotropic, carbon foam of claim 16 wherein said high volatile bituminous coal has a Gieseler initial softening temperature above about 380° C.
- 18) The semi-crystalline, largely isotropic, carbon foam of claim 17 wherein said high volatile bituminous coal has a Gieseler initial softening temperature between about 380° C and about 400° C.
- 19) The semi-crystalline, largely isotropic, carbon foam of claim 16 wherein said high volatile bituminous coal has a plastic range of at least about 50° C.
- 20) The semi-crystalline, largely isotropic, carbon foam of claim 19 wherein said high volatile bituminous coal has a plastic range of from about 75° C to about 100° C.
- 21) The semi-crystalline, largely isotropic, carbon foam of claim 19 wherein said high volatile bituminous coal has a maximum fluidity of at least several hundred ddpm as determined by ASTM D2639.

22) The semi-crystalline, largely isotropic, carbon foam of claim 19 wherein said high volatile bituminous coal has a maximum fluidity of more than 2000 ddpm as determined by ASTM D2639.

23) The semi-crystalline, largely isotropic, carbon foam of claim 19 wherein said high volatile bituminous coal exhibits an expansion of at least about 20% as determined by Arnu dilatation.

24) The semi-crystalline, largely isotropic, carbon foam of claim 23 wherein said high volatile bituminous coal exhibits an expansion of at least about 100% as determined by Arnu dilatation.

25) The semi-crystalline, largely isotropic, carbon foam of claim 23 wherein said high volatile bituminous coal: 1) comprises; A) from about 50 to about 60% by weight of fixed carbon; and B) less than about 30% by weight inert maceral material; 2) exhibits a vitrinite reflectance in the range of from about 0.80 and about 0.95 as determined by ASTM D2798 and 3) exhibits 0.0 volume % moderate or severe oxidation as determined by ASTM D2798.

26) The semi-crystalline, largely isotropic, carbon foam of claim 1 having a density of between about 0.2 g/cm^3 and about 0.6 g/cm^3 .

- 27) The semi-crystalline, largely isotropic, carbon foam of claim 1 having a density of between about 0.3 g/cm^3 and about 0.4 g/cm^3 .
- 28) The method of claim 6 wherein said high volatile bituminous coal contains between about 35% and 45% by weight of volatile matter.
- 29) The method of claim 28 wherein said high volatile bituminous coal has a Gieseler initial softening temperature above about 380° C .
- 30) The method of claim 29 wherein said high volatile bituminous coal has a Gieseler initial softening temperature between about 380° C and about 400° C .
- 31) The method of claim 6 wherein said high volatile bituminous coal has a plastic range of at least about 50° C .
- 32) The method of claim 31 wherein said high volatile bituminous coal has a plastic range of from about 75° C to about 100° C .
- 33) The method of claim 31 wherein said high volatile bituminous coal has a maximum fluidity of at least several hundred ddpm as determined by ASTM D2639.

- 34) The method of claim 31 wherein said high volatile bituminous coal has a maximum fluidity of more than 2000 ddpn as determined by ASTM D2639.
- 35) The method of claim 31 wherein said high volatile bituminous coal exhibits an expansion of at least about 20% as determined by Arnu dilatation.
- 36) The method of claim 35 wherein said high volatile bituminous coal exhibits an expansion of at least about 100% as determined by Arnu dilatation.
- 37) The method of claim 35 wherein said high volatile bituminous coal:
- 1) comprises; A) from about 50 to about 60% by weight of fixed carbon; and B) less than about 30% by weight inert maceral material; 2) exhibits a vitrinite reflectance in the range of from about 0.80 and about 0.95 as determined by ASTM D2798 and 3) exhibits 0.0 volume % moderate or severe oxidation as determined by ASTM D2798.
- 38) The method of claim 6 wherein said carbon foam has a density of between about 0.2 g/cm³ and about 0.6g/cm³.

39) The method of claim 6 wherein said carbon foam has a density of between about 0.3 g/cm³ and about 0.4g/cm³.

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$\frac{d}{dt} \left(\frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$